CLAIMS

1. An airbag module for protecting an occupant of a vehicle from impact, the airbag module comprising:

an inflator that produces inflation gas in response to receipt of an activation signal; and

a cushion positionable within an instrument panel of the vehicle to receive the inflation gas such that the cushion inflates to provide impact protection, wherein the cushion is in a compacted configuration in which the cushion has a small thickness perpendicular to a periphery of the instrument panel, the cushion having an area greater than 150 square inches parallel to the periphery.

2. The airbag module of claim 1, wherein the area is greater than 200 square inches.

3. The airbag module of claim 2, wherein the area is greater than 250 square inches.

4. The airbag module of claim 1, wherein the thickness perpendicular to the periphery is less than two inches along substantially all of the area.

5. The airbag module of claim 2, wherein the thickness perpendicular to the periphery is less than one inch along substantially all of the area.

6. The airbag module of claim 5, wherein the thickness perpendicular to the periphery is less than one-half inch along substantially all of the area.

7. The airbag module of claim 1, further comprising a cover extending along the periphery to conceal the cushion from the occupant, wherein the cover is frangible to permit emergence of the cushion through the periphery.

8. The airbag module of claim 7, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, a bulge is formed proximate the forward edge and the rearward edge is detached from the instrument panel to permit the cover to open.

9. The airbag module of claim 7, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, the cover tears along the forward edge and then rearward of the forward edge to provide a generally U-shaped tear seam.

10. The airbag module of claim 7, wherein the cover comprises a membrane having a pliable construction.

11. The airbag module of claim 10, further comprising a tear initiation member having a generally rigid construction, wherein the tear initiation member is positioned between the cushion and the membrane, the tear initiation member having an edge that is movable in response to pressure from the cushion to form a tear in the membrane.

12. The airbag module of claim 1, wherein the inflator and the cushion are both positioned proximate the periphery and the inflator is displaced from a center of the cushion primarily along a direction parallel to the periphery.

13. The airbag module of claim 12, wherein the inflator is positioned forward of the cushion.

14. The airbag module of claim 12, further comprising a housing positionable to retain the inflator and the cushion, wherein the housing has a generally planar shape oriented generally parallel to the cushion.

15. The airbag module of claim 14, wherein the housing comprises a generally rigid structure that is deformable in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

16. The airbag module of claim 12, further comprising a diffuser having a generally planar shape oriented generally parallel to the cushion, wherein the diffuser comprises a plurality of orifices positioned to receive inflation gas from along a direction generally parallel to the cushion and to direct the inflation gas into the cushion.

17. An airbag module for protecting an occupant of a vehicle from impact, the airbag module comprising:

an inflator that produces inflation gas in response to receipt of an activation signal;

a cushion positionable within an instrument panel of the vehicle to receive the inflation gas such that the cushion inflates to provide impact protection; and

a cover extending along the periphery to conceal the cushion from the occupant;

wherein the inflator is positioned to eject the inflation gas directly into an interior portion of the cushion, wherein the interior portion is separated from the cover by only a single layer of a material of which the cushion is formed.

18. The airbag module of claim 17, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, a bulge is formed proximate the forward edge and the rearward edge is detached from the instrument panel to permit the cover to open.

19. The airbag module of claim 17, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, the cover tears along the forward edge and then rearward of the forward edge to provide a generally U-shaped tear seam.

20. The airbag module of claim 17, wherein the cover comprises a membrane having a pliable construction.

21. The airbag module of claim 20, further comprising a tear initiation member having a generally rigid construction, wherein the tear initiation member is positioned between the cushion and the membrane, the tear initiation member having an edge that is movable in response to pressure from the cushion to form a tear in the membrane.

22. The airbag module of claim 17, wherein the inflator and the cushion are both positioned proximate the periphery and the inflator is displaced from a center of the cushion primarily along a direction parallel to the periphery.

23. The airbag module of claim 22, wherein the inflator is positioned forward of the cushion.

24. The airbag module of claim 22, further comprising a housing positionable to retain the inflator and the cushion, wherein the housing has a generally planar shape oriented generally parallel to the cushion.

25. The airbag module of claim 24, wherein the housing comprises a generally rigid structure that is deformable in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

26. The airbag module of claim 17, wherein the cushion comprises a plurality of folds displaced from the interior portion along a direction generally parallel to the periphery.

27. An airbag module for protecting an occupant of a vehicle from impact, the airbag module comprising:

an inflator that produces inflation gas in response to receipt of an activation signal;

a cushion positionable within an instrument panel of the vehicle to receive the inflation gas such that the cushion inflates to provide impact protection, wherein the cushion is in a compacted configuration in which the cushion has a small thickness perpendicular to a periphery of the instrument panel; and

a housing positionable within the instrument panel to retain the inflator and the cushion such that the inflator and the cushion, in the compacted configuration, are both positioned proximate the periphery and the inflator is displaced from a center of the cushion primarily along a direction parallel to the periphery.

28. The airbag module of claim 27, further comprising a cover extending along the periphery to conceal the cushion from the occupant, wherein the cover is frangible to permit emergence of the cushion through the periphery.

29. The airbag module of claim 28, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, a bulge is formed proximate the forward edge and the rearward edge is detached from the instrument panel to permit the cover to open.

30. The airbag module of claim 28, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, the cover tears along the forward edge and then rearward of the forward edge to provide a generally U-shaped tear seam.

31. The airbag module of claim 28, wherein the cover comprises a membrane having a pliable construction.

32. The airbag module of claim 31, further comprising a tear initiation member having a generally rigid construction, wherein the tear initiation member is positioned between the cushion and the membrane, the tear initiation member having an edge that is movable in response to pressure from the cushion to form a tear in the membrane.

33. The airbag module of claim 28, wherein the inflator is displaced from the cover by a distance of less than two inches.

34. The airbag module of claim 27, wherein the inflator is positioned forward of the cushion.

35. The airbag module of claim 27, wherein the housing has a generally planar shape oriented generally parallel to the cushion.

36. The airbag module of claim 35, wherein the housing comprises a generally rigid structure that is deformable in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

37. The airbag module of claim 27, wherein the housing comprises a diffuser having a generally planar shape oriented generally parallel to the cushion, wherein the diffuser comprises a plurality of orifices positioned to receive inflation gas from along a direction generally parallel to the cushion and to direct the inflation gas into the cushion.

38. An airbag module for protecting an occupant of a vehicle from impact, the airbag module comprising:

an inflator that produces inflation gas in response to receipt of an activation signal;

a cushion positionable to receive the inflation gas such that the cushion inflates to provide impact protection; and

a housing positionable to retain the inflator and the cushion, wherein the housing comprises a generally rigid structure that is deformable in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

39. The airbag module of claim 38, wherein the cushion is positionable within an instrument panel of the vehicle, the airbag module further comprising a cover extending along a periphery of the instrument panel to conceal the cushion from the occupant, wherein the cover is frangible to permit emergence of the cushion through the periphery.

40. The airbag module of claim 39, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, a bulge is formed proximate the forward edge and the rearward edge is detached from the instrument panel to permit the cover to open.

41. The airbag module of claim 39, wherein the cover comprises a forward edge and a rearward edge, wherein, in response to expansion of the cushion, the cover tears along the forward edge and then rearward of the forward edge to provide a generally U-shaped tear seam.

42. The airbag module of claim 39, wherein the cover comprises a membrane having a pliable construction.

43. The airbag module of claim 42, further comprising a tear initiation member having a generally rigid construction, wherein the tear initiation member is positioned between the cushion and the membrane, the tear initiation member having an edge that is movable in response to pressure from the cushion to form a tear in the membrane.

44. The airbag module of claim 38, wherein the cushion is positionable within an instrument panel of the vehicle, wherein the inflator and the cushion are both positioned proximate a periphery of the instrument panel and the inflator is displaced from a center of the cushion primarily along a direction parallel to the periphery.

45. The airbag module of claim 44, wherein the inflator is positioned forward of the cushion.

46. The airbag module of claim 45, wherein the housing is positioned to retain the inflator and the cushion, wherein the housing has a generally flat surface oriented generally parallel to the cushion, wherein the generally flat surface is bendable into the instrument panel in response to pressure of inflation gas within the cushion.

47. The airbag module of claim 44, wherein the housing comprises a diffuser having a generally planar shape oriented generally parallel to the cushion, wherein the diffuser comprises a plurality of orifices positioned to receive inflation gas from along a direction generally parallel to the cushion and to direct the inflation gas into the cushion.

48. A method for manufacturing an airbag module for protecting an occupant of a vehicle from impact, wherein the airbag module is designed to be installed in an instrument panel of the vehicle, the instrument panel having a periphery, the airbag module having an inflator, a cushion, and a housing, the method comprising:

compacting the cushion; and

coupling the inflator and the cushion to the housing such that the cushion is positioned to receive inflation gas from the inflator, wherein the cushion, housing, and inflator form the airbag module shaped such that, after installation in the instrument panel, the cushion has a small thickness perpendicular to the periphery and an area greater than 150 square inches parallel to the periphery.

49. The method of claim 48, wherein the area is greater than 250 square inches.

50. The method of claim 48, wherein the thickness perpendicular to the periphery is less than two inches along substantially all of the area.

51. The method of claim 48, wherein the airbag module further comprises a cover that is frangible to permit emergence of the cushion through the periphery, the method further comprising coupling the cover to the housing such that, after installation of the airbag module in the instrument panel, the cover extends along the periphery to conceal the cushion from the occupant.

52. The method of claim 51, wherein the cover comprises a membrane having a pliable construction, wherein coupling the cover to the cushion comprises stretching the membrane over the cushion.

53. The method of claim 52, wherein airbag module further comprises a tear initiation member having a generally rigid construction, the method further comprising positioning the tear initiation member between the cushion and the membrane, wherein the tear initiation member has an edge that is movable in response to pressure from the cushion to form a tear in the membrane.

54. The method of claim 48, wherein coupling the inflator and the cushion to the housing comprises positioning the inflator and the cushion such that, after installation of the airbag module in the instrument panel, the inflator and the cushion are both proximate the periphery and the inflator is displaced from a center of the cushion primarily along a direction parallel to the periphery.

55. The method of claim 54, coupling the inflator and the cushion to the housing comprises positioning the inflator and the cushion such that, after installation of the airbag module in the instrument panel, the inflator is forward of the cushion.

56. The method of claim 54, wherein the housing has a generally planar shape, wherein coupling the inflator and the cushion to the housing comprises orienting the housing generally parallel to the cushion, wherein the housing comprises a generally rigid structure that is deformable in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

57. The method of claim 54, wherein the housing is shaped to form a diffuser having a generally planar shape with a plurality of orifices, wherein coupling the inflator and the cushion to the housing comprises orienting the diffuser generally parallel to the cushion such that the orifices are positioned to receive inflation gas from along a direction generally parallel to the cushion and to direct the inflation gas into the cushion.

58. A method for protecting an occupant of a vehicle from impact through the use of an airbag module installed in an instrument panel of the vehicle, the airbag module comprising an inflator, a cushion, and a cover, the method comprising:

transmitting an activation signal to trigger production of inflation gas by the inflator;

ejecting the inflation gas from the inflator directly into an interior portion of the cushion, wherein the interior portion is separated from the cover by only a single layer of a material of which the cushion is formed, wherein the cover extends along a periphery of the instrument panel; and

rupturing the cover to permit the cushion to emerge from within the instrument panel to provide impact protection.

59. The method of claim 58, wherein the cover comprises a forward edge and a rearward edge, wherein rupturing the cover comprises:

forming a bulge proximate the forward edge; and

detaching the rearward edge from the instrument panel to permit the cover to open.

60. The method of claim 58, wherein the inflator and the cushion are both positioned proximate the periphery and the inflator is displaced forward of the cushion, wherein ejecting the inflation gas from the inflator directly into the interior portion comprises moving the inflation gas rearward.

61. The method of claim 60, wherein the airbag module further comprises a housing positioned to retain the cushion and the inflator, the housing having a generally planar shape, the method further comprising:

receiving impact of the occupant against the cushion; and

deforming the housing in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

62. The method of claim 58, wherein the cushion comprises a plurality of folds displaced from the interior portion along a direction generally parallel to the periphery, the method further comprising conveying the inflation gas from the interior portion into the folds to induce the cushion to unfold.

63. A method for protecting an occupant of a vehicle from impact through the use of an airbag module comprising an inflator, a cushion, and a housing, the method comprising:

transmitting an activation signal to trigger production of inflation gas by the inflator, wherein the housing retains the inflator and the cushion;

directing the inflation gas into the cushion to inflate the cushion;

receiving impact of the occupant against the cushion; and

deforming the housing in response to impact of the occupant against the cushion to absorb kinetic energy from the occupant.

64. The method of claim 63, wherein the cushion is positionable within an instrument panel of the vehicle, wherein the airbag module further comprises a cover extending along a periphery of the instrument panel, the method further comprising rupturing the cover to permit the cushion to emerge from within the instrument panel.

65. The method of claim 64, wherein the cover comprises a forward edge and a rearward edge, wherein rupturing the cover comprises:

forming a bulge proximate the forward edge; and

detaching the rearward edge from the instrument panel to permit the cover to open.

66. The method of claim 63, wherein the inflator and the cushion are both positioned proximate the periphery and the inflator is displaced forward of the cushion, wherein directing the inflation gas into the cushion comprises moving the inflation gas rearward.

67. The method of claim 66, wherein the airbag module further comprises a housing positioned to retain the cushion and the inflator, the housing having a generally flat surface oriented generally parallel to the cushion, wherein deforming the housing comprises bending the generally flat surface into the instrument panel in response to pressure of inflation gas within the cushion.

68. The method of claim 66, wherein the housing comprises a diffuser having a generally planar shape oriented generally parallel to the cushion, wherein directing the inflation gas into the cushion comprises moving the inflation gas within the diffuser, along a direction generally parallel to the cushion to reach a plurality of orifices of the diffuser.